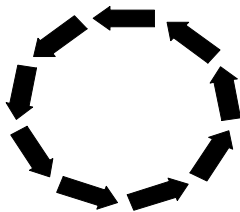


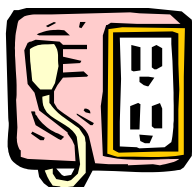
TECHNICAL FACT SHEET FOR CHROMIUM HAZARDS AND ALTERNATIVES



EPA PARTNERSHIP AND YOU...

Chromium compounds are considered highly toxic to humans. Chromium (VI), or hexachrome, can cause ulcers of the skin, irritation of the nasal mucosa, and irritation of the gastrointestinal tract, and adverse effects in the kidneys and liver. Based on animal and human studies, chromium (VI) and its compounds should be considered probable carcinogens in humans exposed by inhalation.

The United States Environmental Protection Agency (EPA) has identified numerous persistent, bioaccumulative and/or toxic chemicals that may be present in some industrial hazardous wastes regulated under the Resource Conservation and Recovery Act (RCRA). In addition to its ongoing regulatory activities, EPA will encourage efforts to achieve reduction of the generation of chemicals that are either persistent, bioaccumulative and/or toxic. EPA will also work with states, industry, and environmental groups through workshops, technical assistance programs, partnership agreements, regulatory reinvention projects, and other strategies to promote progress toward the goal of reducing the generation of RCRA PBT's in hazardous waste by 50 percent by the year 2005.



THE CHROMIUM CONNECTION

Chromium (III) occurs naturally in the environment. Chromium (VI) is generally produced by industrial processes, and used in such industries as pigment manufacturing, leather tanning, wood treatment and chrome plating. The primary use for chromium compounds containing chromium (VI) is in the metal finishing industry for both decorative and functional purposes. Chromium is often chosen as a surface finish because it possesses a low coefficient of friction, high hardness, good corrosion resistance, high heat resistance and anti-galling properties. Due to its toxicity and suspected carcinogenicity, however, chromium is heavily regulated for the protection of human health and of the environment. These regulatory requirements, as well as the growing awareness among metal platers regarding the health effects of chromium exposure, have led to a search for acceptable alternatives to using chromium in the electroplating industry.

Here are some of the uses for chromium:

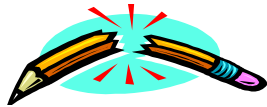
- Corrosion resistance for metals
- Gives metals longer wear
- Electrical insulation of metals
- Decorative purposes (for metals)
- As chromium sulfate, used to stabilize collagen in hides when tanning leather
- A component of pigments used in the printing industry
- A component of paint used in industrial applications

Here are some of the industries that may use chromium:

- Automotive manufacturing/repair
- Aerospace industry
- Leather tanneries
- Metal finishers
- Pigment manufacturing
- Printing
- Painting
- Wood treatment

BREAKING THE TIE WITH CHROMIUM

There is no known single replacement for chromium in electroplating and other process, however, there are some alternative technologies available that can replace electroplating in specific applications. Testing should be done on a site-specific basis to determine the most feasible coating alternative. In many cases, alternative surface finishes prove to be cost-effective and environmentally beneficial replacements for chromium.



Here are several chromium alternatives:

Electroless Plating - Electroless plating is a process in which metal ions in a dilute aqueous solution are deposited onto a substrate by means of a continuous reaction. Many metals and alloys can be deposited onto substrates by electroless plating, but nickel is the most common replacement for chromium. Nickel coatings have excellent wear and corrosion resistance, and may be used in a wide range of applications. However, risks from hazardous vapor and corrosive chemicals still exist in this process.

Chemical Vapor Deposition (CVD) - Chemical vapor deposition, or CVD, is a process in which a coating is deposited onto a substrate by a reactive vapor that is typically a metal halide, metal carbonyl, hydride, or organometallic compound. CVD provides a thick, dense, high-purity film on substrates. Due to the high temperatures necessary to complete this process, temperature-sensitive substrates cannot be coated with CVD.

Surface Hardening - Surface hardening is a process in which a steel substrate is heated to the lowest temperature at which a gaseous medium (typically carbon or nitrogen) will absorb and diffuse into the surface. Substrates that are

subjected to surface hardening demonstrate good wear resistance; however, use of this process is also limited to heat-resistant substrates. Some of the spent baths used after coating may be considered to be hazardous waste.

Thermal Spraying - Thermal spraying is a particle impact method in which a coating material is melted and then projected toward a substrate with compressed air or gas. Thermal spraying offers corrosion and wear resistance, but cannot effectively coat complex substrates. This process also generates dust and fumes that may be health hazards.

Physical Vapor Deposition/Vacuum Coating - Vacuum coating uses positive ions or neutral atoms to bombard a substrate with coating material. This technology is environmentally benign, very versatile, and offers improved adhesion and film structure. The downside of vacuum coating is its high capital cost, high voltage requirements, and use of toxic chemicals.

Other Chromium Plating Alternatives - Other metal finishing technologies include the use of sulfuric acid anodizing, In-Mold Plating, the application of zirconium oxide coating or applying other composites or alloys as surface treatments. One of these alternative finishing technologies may be a viable chromium plating alternative depending on the composition and the functional requirements of the parts that are to be treated.

In the Wood Treatment Industries - Several alternatives exist in the wood preservation industry which replace chromium-based products. Boron-based sprays, dusts or pastes can be applied to the wood's surface to help in reducing decay. Another option for protecting wood without using chromium is by inserting boron-treated rods directly into the body of the wood.

These rods will dissolve and will then diffuse throughout the wood as the moisture content increases, thus treating and protecting the wood.



In the Printing and Painting Industries - Waste paint and printing inks sometimes contain chromium. In addition, when specific types of aerosol paints are applied, small amounts of chromium in the paint can be released into the air and inhaled. Alternative coatings, such as electrostatic or powder coatings, in addition to the use of chromium-free paints should be considered and tests performed on a site-specific basis to determine the most feasible coating alternative.

In addition, process modifications can reduce chromium waste generation and allow for the recycling of chromium within various industrial processes. Though these methods are commonly associated with metal finishing, similar methods can be implemented in a wide variety of industries with similar results. Process modifications in addition to chromium alternatives can reduce waste disposal and input material costs while lessening environmental impacts and creating a positive business image.

Here are several examples of chromium process modifications:

Dragout Recovery and Reduction - Dragout recovery and reduction can be accomplished in many ways. Reducing surface area and using designs which promote rapid drainage from plating racks can lead to reduced dragout volumes by maximizing drainage directly into process tanks. In a similar fashion, dragout drain boards and drip tanks allow plating solutions to be returned directly to the process tanks. Implementing revised rinsing techniques and technologies which reduce rinse volumes and limit the introduction of impurities can allow rinse solutions to be returned to the plating process. The added water present in the rinse solution can compensate for evaporative losses.

Evaporation - Evaporation is a commonly used method for the recovery of metal salts used in the metal finishing industry. This process concentrates the plating chemicals through evaporation of plating solutions. The resulting concentrated solution can then be reintroduced into the process tanks and reduce the need for the addition of new raw materials. In addition, some evaporative recovery systems contain systems which condense the water vapor removed from the plating solution. The resulting water can then be reintroduced into process tanks, further reducing costs.



Reverse Osmosis - Reverse osmosis systems are similar to evaporative systems since they can recover both plating solutions and water. Reverse osmosis relies on a membrane through which water can pass, but plating chemicals cannot. By circulating plating solutions through this membrane, plating chemicals and water are separated. The resulting concentrated plating solution can then be returned to the process tanks and the resulting water can be reintroduced into the system as rinse and make-up water.

Other Technologies - Other technologies or management practices such as the application of fluorosurfactant fume suppressant, using tank chemistry monitors, and using written procedures for bath make-up and additions may reduce chromium waste generation.

MEASURE YOUR SUCCESS



There are many companies that have implemented successful chromium alternatives and chromium reduction plans in their process operations. Many companies have also benefitted from savings in reducing chromium use and replacing chromium with the more environmentally friendly alternatives. Here are some success stories for several types of chromium reduction and replacement alternatives:

- A plating plant in Ohio reduced its annual chromium use from 700 pounds to 400 pounds while also maintaining identical production. The plant accomplished this chromium reduction by installing a closed-loop electropolish process that pipes rinse water through a heavy metal exchange cylinder and reuses it in the process. They also converted a stave rinse to a spray rinse, saving 200 pounds of chrome per year.
- A tannery was found to have the potential to reduce chromium wastes by utilizing the following techniques; recycle used chromium effluent (savings of \$5,000/yr); precipitate chromium wastes with hydroxide, settle, and re-dissolve with acid and reuse, reducing chromium in the wastewater and saving \$1,000/yr. The implementation of these techniques could reduce chromium purchases by 2 metric tons per year.
- A company replaced its chrome bright-dipping process (used on brass kitchen fixtures) with a hydrogen peroxide-based process. This change resulted in a reduction in the quantity of chromium waste and a reduction in the consumption of materials used to treat chromium wastes. There was no significant cost associated with the replacement of chromium, and resulted in a savings of approximately \$6,000 per year.
- Another plating company reconfigured their rinse tanks using some of the process modifications previously mentioned and decreased water flow rates

which initially reduced their wastewater discharge by 50 percent. In addition, inexpensive flow restrictors were installed to reduce the flow of water into rinse tanks. This modification further reduced daily wastewater discharges from 40,000 gallons to 11,000 gallons. Not only did this modification have a positive impact on the environment, but it saved the company over \$18,000 annually. These modifications in addition to other waste volume reduction techniques have resulted in an total annual savings of nearly \$24,000 while maintaining production rates and quality standards.

- An extremely inexpensive (\$500) and easily accomplished process modification involving the redesign of a parts plating basket resulted in a dragout reduction of approximately 55 percent, reduced wastewater discharge concentrations, and reduced raw material costs by \$250 per year. While not as complex or dramatic as other process modifications, simple waste reduction steps can have significant positive effects on the environment and the bottom line.

FOR MORE INFORMATION...

There are various resources to locate more information on chromium reduction and alternatives for your workplace. Here are just a few of the websites available via the Internet and government agencies listings that would be able to provide more information.

Websites

- ☞ www.epa.gov/reg5rcra/wptdiv/p2pages/index.html
- ☞ www.manufacturing.net/magazine
- ☞ buzz.ea.ucla.edu/cct.froines.news.html
- ☞ www.sni.net/light/p3/cdphe_05.htm
- ☞ www.turi.ort/P2GEMS
- ☞ www.emcentre.com
- ☞ www.mntap.umn.edu
- ☞ metalfinishing-sc.com
- ☞ www.epa.ohio.gov/opp
- ☞ es.epa.gov/studies (EnviroSense)
- ☞ www.pprc.org/pprc
- ☞ www.deq.state.mi.us/ead/p2sect/
- ☞ www.epa.gov/opptintr/p2home
- ☞ www.surfacefinishing.com
- ☞ www.pwrc.usgs.gov/new/chrback.htm

Government Listings

U.S. EPA Region 5

P2 Hotline

⇒ 888/745-7272 (888-PIK-P2P2)

Illinois Environmental Protection Agency

Office of Pollution Prevention

⇒ 217/782-8700

Indiana Dept. of Environmental Mgmt.

Office of Pollution Prevention

⇒ 317/232-8172

Michigan Dept. of Environmental Quality

Environmental Assistance Division

⇒ 800/662-9278

Minnesota Technical Assistance Program

⇒ 612/624-1300

Ohio Environmental Protection Agency

Office of Pollution Prevention

⇒ 614/644-3469

Wisconsin Dept. of Natural Resources

Cooperative Environmental Assistance

⇒ 608/267-9700



